

REMARKS/ARGUMENTS

The present Amendment is in response to the Final Office Action mailed December 16, 2003 in the above-identified application. Enclosed herewith a petition requesting a two month extension of time for resetting the deadline for responding to the Final Office Action from March 16, 2004 to and including May 16, 2004.

In the Final Office Action, the Examiner rejected claims 1-5, 7-10 and 12-24 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0076490 to Chiang et al. in view of U.S. Patent No. 6,442,950 to Tung and U.S. Patent No. 3,564,454 to Schrader. Referring to FIGS. 13 and 25 thereof, Chiang discloses a process chamber 12 having a moveable shield 14. As shown in FIG. 25 thereof, Chiang's shield 14 includes a channel 304 for receiving a cooling or heating fluid. The cooling or heating fluid flows into shield 14 through at least one hollow shield support leg 306, which extends through shield cap 196 into channel 304. As described in paragraph 148 of the Chiang reference, the channel 304 is "annular and runs about two-thirds of the way around the base of shield 14." Thus, Chiang fails to teach that an internal cavity of a cylindrical shutter extends completely around a wafer carrier secured within a reaction chamber, as required by claim 1 of the present application. Applicants note that the Examiner has acknowledged this deficiency in Chiang.

In order to overcome the above-noted deficiency in Chiang, the Examiner cited Tung. Referring to FIG. 3A thereof, Tung teaches a reaction chamber having an inner wall 33 defining a space for accommodating a wafer, and a removable shield liner 37 substantially surrounding the wafer and covering portions of the inner wall. The inner wall 33 and the removable shield liner 37 define a sealed space 38 adapted to receive a temperature-controlling gas in thermal communication with the removable liner for controlling the internal temperature of the reaction chamber.

The Examiner has also cited Schrader as teaching the use of a wafer carrier being secured within a reaction chamber, whereby a cylindrical shutter completely surrounds at least one of the wafer carriers.

In response to the Examiner's Section 103(a) rejection under Chiang, Tung and Schrader, Applicants submit herewith Declarations pursuant to 37 C.F.R. § 1.131. In the Declarations, each of the inventors has declared a reduction to practice of the invention claimed in the present application before December 15, 2000. Thus, the invention claimed in the present application was conceived and reduced to practice prior to the earliest priority dates of both Chiang and Tung. In view of the above facts, Applicants respectfully request that the Examiner remove Chiang and Tung as prior art references and allow claims 1-5, 7-10 and 12-24.

Applicants also note that Tung discloses a removable shield liner 37 that substantially surrounds a wafer and covers portions of an inner wall of a reactor. Applicants respectfully assert that one skilled in the art would have no motivation to combine Tung with Chiang's shutter that is moveable between open and closed positions. Applicants respectfully assert that the Examiner has engaged in prohibited hindsight reconstruction by using the claims of the present application as a roadmap for piecing together the prior art. In addition, even if one were motivated to combine Chiang and Tung, the combination would not produce the limitations found in claim 1 of the present application. For all of these reasons, Applicants respectfully assert that claims 1-5, 7-10 and 12-24 are unobvious over the references cited by the Examiner and are otherwise allowable.

The Examiner also rejected claim 6 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Chiang, Tung and Schrader and further in view of Japanese Patent No. 07-0707302 to Kawada et al. The Examiner has cited Kawada as teaching a reactor made of stainless steel. In response, Applicants respectfully assert that Kawada does not overcome the deficiencies noted above in Chiang, Tung and Schrader.


In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

If, however, for any reason the Examiner does not believe that such action can be taken at this time, it is respectfully requested that she telephone Applicants' attorney at (908) 654-5000 in order to overcome any additional objections which she might have.

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge Deposit Account No. 12-1095 therefor.

Dated: May 13, 2004

Respectfully submitted,

By 

Michael J. Doherty

Registration No.: 40,592
LERNER, DAVID, LITTENBERG,
KRUMHOLZ & MENTLIK, LLP
600 South Avenue West
Westfield, New Jersey 07090
(908) 654-5000
Attorney for Applicant

493081_1.DOC

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please do not report the images to the
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3. On December 23, 2003, Application No. 10/046,426 was assigned from Encore Corporation to Veeco Instruments Inc. A Patent Assignment for Application No. 10/046,426 was recorded in the United States Patent and Trademark Office at Reel 014242, Frame 0267, on January 8, 2004. A copy of the Patent Assignment is annexed hereto as Exhibit A.

4. I am aware that Application No. 10/046,426 claims benefit of U.S. Provisional Application Ser. No. 60/296,598, filed June 7, 2001.

5. I invented the subject matter of Application No. 10/046,426, including at least one of the claims therein, with Scott Elman, Keng Moy and Vadim Boguslavskiy, and in accordance with our invention, we reduced the invention to practice prior to December 15, 2000.

6. I am familiar with the prosecution of Application No. 10/046,426, including the Office Action mailed December 16, 2003. In particular, this Office Action includes a rejection based in part upon U.S. Patent Application Publication No. U.S. 2002/0076490 to Chiang et al. (the '490 published application) and U.S. Patent No. 6,442,950 to Tung (the '950 patent).

7. I make this Declaration under 37 C.F.R. § 1.131 in order to present a showing of facts establishing a reduction to practice of the invention claimed in Application No. 10/046,426 in this country prior to December 15, 2000, which is the earliest effective filing date of the '490 published application.

8. All of the facts described herein took place in the United States.

9. Annexed hereto is Exhibit B, which is a true copy of an Emcore Patent Disclosure, the date of which has been redacted, but which predates December 15, 2000. The disclosure details a reactor for epitaxial deposition having a cylindrical shutter with an internal cavity for receiving a coolant, which discloses each and every feature of the reactor as claimed in at least one pending claim of Application No. 10/046,426. As set forth in the patent disclosure, my invention is described as a reactor for growing epitaxial layers including an airtight reaction chamber having a passthrough opening for inserting and removing wafer carriers from the reaction chamber, and a cylindrical shutter located inside the reaction chamber for selectively closing the passthrough opening, the cylindrical shutter being movable between a first position for closing the passthrough opening and a second position for opening the passthrough opening, whereby the cylindrical shutter has an internal cavity adapted to receive a cooling fluid.

10. Annexed hereto is Exhibit C, which is a true copy of an Emcore print, the date of which has been redacted, but which predates December 15, 2000. The print details a cylindrical shutter having an internal cavity for receiving a coolant.

11. Prior to December 15, 2000, we thus invented and actually reduced to practice a reactor for growing epitaxial layers having a cylindrical shutter with an internal cavity adapted to receive a cooling fluid.

12. It is submitted that the foregoing presentation of facts and supporting documentation establishes the completion of Applicants' claimed invention and that such completion predates December 15, 2000.

13. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

05/12/2004

Date

Alex Gurary

ALEXANDER GURARY

Attachments:

- Exhibit A - Merger Document
- Exhibit B - Emcore Corporation Patent Disclosure
- Exhibit C - Emcore Corporation Print

3.0-069

Docket No.: F53342

FORM PTO-1595 (Modified)
(Rev. 03-01)
OMB No. 0651-0027 (exp. 3/31/2002)
P08/REV03

RECORDATION FORM COVER SHEET

U.S. DEPARTMENT OF COMMERCE
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To the Director of the United States Patent and Trademark Office: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
EMCORE Corporation

2. Name and address of receiving party(ies):

Name: **Veeco Instruments Inc.**

Internal Address: _____

Street Address: _____

City: **Woodbury** State: **NY** ZIP: **11797**

Additional names(s) of conveying party(ies)

☒ Yes ☐ No

3. Nature of conveyance:

☒ Assignment

☐ Merger

☐ Security Agreement

☐ Change of Name

☐ Other _____

Execution Date: **December 22, 2003**

Additional name(s) & address(es) attached? ☐ Yes ☒ No

4. Application number(s) or patent numbers(s):

If this document is being filed together with a new application, the execution date of the application is: _____

A. Patent Application No.(s)

B. Patent No.(s)

09/619,254 60/514,959
10/046,426
10/304,646
10/268,464

4,714,091 5,336,324 5,835,678
4,772,356 5,544,618 6,001,183
4,838,983 5,759,281 6,080,241
4,969,416 5,835,677 6,197,121

Additional numbers attached? ☒ Yes ☐ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: **Phillip Braginsky**

Internal Address: _____

Street Address: _____

City: **Garden City** State: **NY** ZIP: **11530**

6. Total number of applications and patents involved: **22**

7. Total fee (37 CFR 3.41):.....\$ **880.00**

☐ Enclosed - Any excess or insufficiency should be credited or debited to deposit account

☒ Authorized to be charged to deposit account

8. Deposit account number:

19-1013

(Attach duplicate copy of this page if paying by deposit account)

9. Statement and signature.

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Phillip Braginsky, 40,527

Name of Person Signing

Signature

January 8, 2004

Date

Total number of pages including cover sheet, attachments, and document: **6**

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PATENT

REEL: 014242 FRAME: 0265

700059763

CH \$880.00 191013 09619254

Additional patent numbers:

6,368,404

6,349,270

6,492,625

6,506,252

6,547,876

PATENT
REEL: 014242 FRAME: 0266

Patent Assignment

WHEREAS, **EMCORE** Corporation (hereinafter, "Assignor"), a New Jersey corporation with a place of business at 145 Belmont Drive, Somerset, NJ is the owner of rights in certain patents and/or patent applications listed in the attached Schedule, and the inventions disclosed and claimed therein (the "Patents");

WHEREAS, **Veeco Instruments Inc.** (hereinafter, "Assignee"), a corporation organized and existing under the laws of the State of Delaware with offices at 100 Sunnyside Blvd., Suite B, Woodbury, NY 11797-2902, United States of America, desires to acquire Assignor's entire right, title, and interest in and to the Patents; and

WHEREAS, Assignor and Assignee have entered into an Intellectual Property Agreement pursuant to which Assignor has agreed to assign certain proprietary technology, including the Patents, to Assignee.

NOW THEREFORE, effective immediately by this document, and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor does hereby sell, assign and transfer to Assignee, and its successors and assigns, Assignor's entire right, title, and interest, in the United States and all foreign countries, in the Patents, and all continuations, divisions, extensions, reexaminations, reissues, and substitutes thereof, rights of priority under the International Convention for the Protection of Industrial Property, the Inter-American Convention Relating to Patents, Designs and Industrial Models, and any other international agreements to which the United States adheres, and in and to all income, royalties, damages, claims, and payments now or hereafter due or payable with respect thereto, and in and to all causes of action (either in law or in equity) and the right to sue, counterclaim, and recover for past, present, and future infringement of the rights assigned to Assignee hereunder.

Assignor hereby agrees to execute any papers and to perform such other proper acts as reasonably necessary to secure to Assignee or to its successors or assigns, the rights, title and interest hereby transferred.

WHEREFORE, Assignor has duly executed this Patent Assignment on the date indicated below.

("Assignor")

By:



Howard Brodie
Vice President & General Counsel

Date: December 22, 2003

[STATE OF New Jersey]

COUNTY OF Monmouth)

On this 22 day of December 2003 before me, a Notary Public in and for the County of Monmouth in the State of New Jersey, personally appeared Howard W. Brodie, and being duly sworn, averred that, being duly authorized, he executed the foregoing Assignment as his free and voluntary act for the uses and purposes therein set forth.

NOTARY PUBLIC

My Commission Expires: 5/1/2007]

SILVIA GENTILE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires May 1, 2007

U.S. Patent No. 6,506,252
Chinese Patent Appln. No. 01822507.1
European Patent Appln. No. 01964250.3
Japanese Patent Appln. No. 2002-562804
Korean Patent Appln. No. 10-2003-7010387

SUSCEPTORLESS REACTOR FOR GROWING
EPITAXIAL LAYERS ON WAFERS BY CVD

U.S. Patent No. 6,547,876

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS BY CHEMICAL VAPOR
DEPOSITION

U.S. Patent Appln. No. 09/619,254
European Patent Appln. No. 00952166.7
Japanese Patent Appln. No. 512955/2001
Korean Patent Appln. No. 2002-701052
Taiwan Patent No. NI-154647

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS USING LOW PRESSURE
INTERFACE AND METHODS THEREOF

U.S. Patent Appln. No. 10/046,426

REACTOR HAVING A MOVABLE SHUTTER

U.S. Patent Appln. No. 10/304,646
U.S. Patent Appln. No. 10/268,464

SUSCEPTORLESS REACTOR FOR GROWING
EPITAXIAL LAYERS ON WAFERS BY
CHEMICAL VAPOR DEPOSITION

U.S. Patent Appln. No. 09/619,254

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS USING LOW PRESSURE
INTERFACE AND METHODS THEREFOR

U.S. Provisional Appln. No. 60/514,959

WAFER CARRIER FOR GROWING GaN
WAFERS

PCT/US03/26112
Taiwan Patent Appln. No. 092125071

ALKYL PUSH FLOW FOR VERTICAL FLOW
ROTATING DISK REACTORS

N/A

METHOD AND DEVICE FOR WAFER AND
CARRIER CONTROL DURING MOCVD OF
GaN RELATED MATERIALS

Patent Schedule

U.S. Patent No. 4,714,091
Japanese Patent No. 1758220

MODULAR GAS HANDLING APPARATUS

U.S. Patent No. 4,772,356
U.S. Patent No. 4,838,983
U.S. Patent No. 4,969,416

GAS TREATMENT APPARATUS AND METHOD

U.S. Patent No. 5,336,324
U.S. Patent No. 5,544,618

APPARATUS FOR DEPOSITING A COATING
ON A SUBSTRATE

U.S. Patent No. 5,759,281

CVD REACTOR FOR UNIFORM HEATING
WITH RADIANT HEATING ELEMENTS

U.S. Patent No. 5,835,677
U.S. Patent No. 5,835,678

LIQUID VAPORIZER SYSTEM AND METHOD

U.S. Patent No. 6,001,183

WAFER CARRIERS FOR EPITAXIAL
GROWTH PROCESSES

U.S. Patent No. 6,080,241

CHEMICAL VAPOR DEPOSITIONS CHAMBER
HAVING AN ADJUSTABLE FLOW FLANGE

U.S. Patent No. 6,197,121

CHEMICAL VAPOR DEPOSITION
APPARATUS

U.S. Patent No. 6,368,404

INDUCTION HEATING CHEMICAL VAPOR
DEPOSITION REACTOR

U.S. Patent No. 6,349,270

METHOD AND APPARATUS FOR
MEASURING THE TEMPERATURE OF
OBJECTS ON A FAST MOVING HOLDER

U.S. Patent No. 6,492,625
Chinese Patent Appln. No. 01819511.3
European Patent Appln. No. 01957492.0
Japanese Patent Appln. No. 2002-530254
Korean Patent Appln. No. 10-2003-7003837

APPARATUS AND METHOD FOR
CONTROLLING TEMPERATURE
UNIFORMITY OF SUBSTRATES

REACTOR FOR HIGH TEMPERATURE EPITAXIAL DEPOSITION

EMCORE Corporation, 145 Belmont Drive, Somerset, NJ 08873

Authors: Keng Moy, Scott Elman, Vadim Boguslavskiy, Alex Gurary

PATENT DISCLOSURE

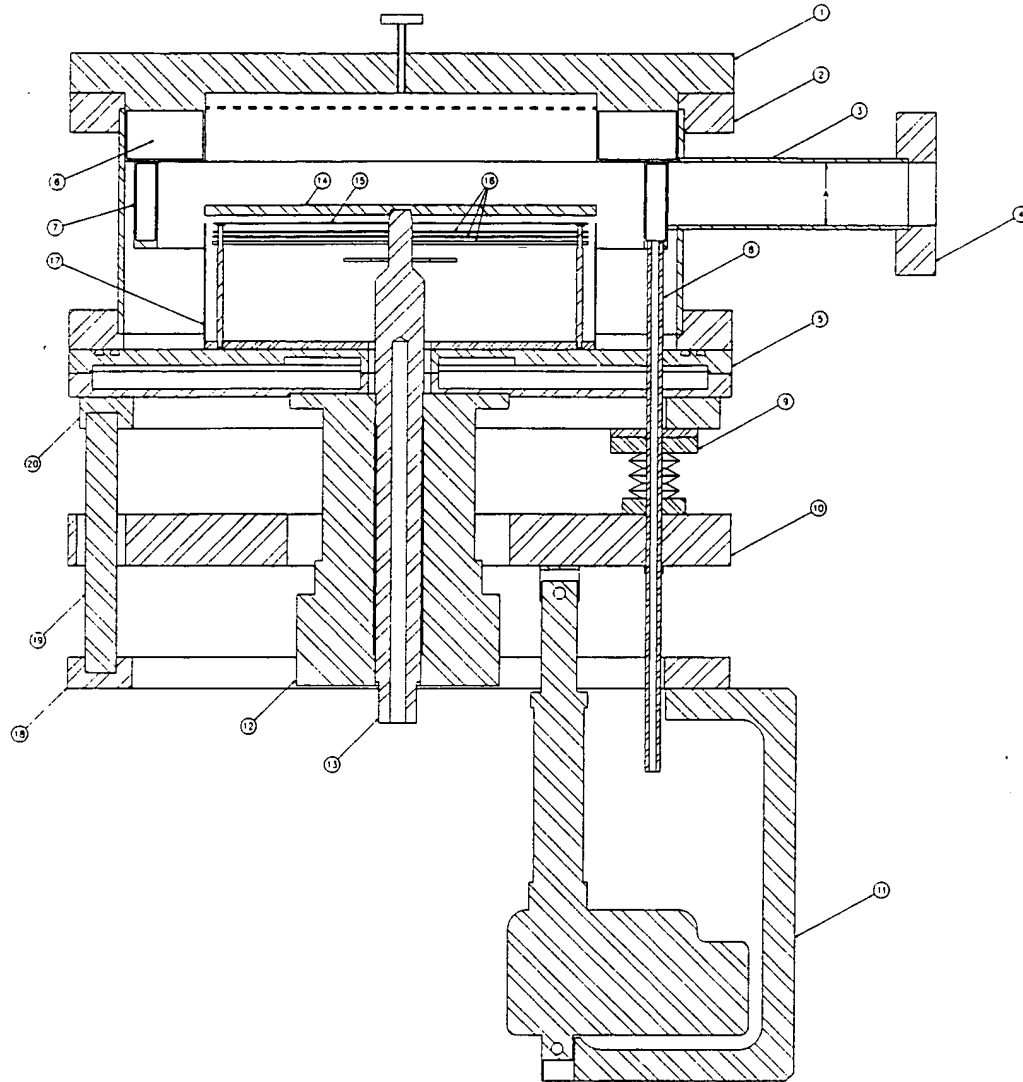


Figure 1. Schematics of the reactor for high temperature epitaxial deposition

Abstract.

Object of the invention is a reactor for high temperature epitaxial deposition with mechanism for wafer carrier transfer in and out reactor which do not produce disturbance in the axisymmetric uniformity of thermal and flow field inside reactor and, hence, provides for extremely uniform epitaxial deposition. Invention is applicable preferably to axisymmetric reactor for epitaxial deposition of SiC (1600 C) and GaN (1100 C). Additionally invention is applicable for epitaxial reactor based on the high speed vertical rotating disk technology.

Background of the invention.

Most of production level epitaxial deposition reactors have a cylindrical shape with opening on the side wall to transfer wafer carriers in and out of the reactor. Opening on the side is connected through the gate valve with load lock which allows the reactor to be open each run while maintaining a low level of contamination in the reactor environment required for the advanced epitaxial deposition. During the deposition run the opening on the wall is covered by the special movable shutter with surface larger than opening to prevent gate valve overheating and particles formation. Unfortunately shutter also provides disturbance in the process flow dynamic (because to provide its movement shutter could not perfectly fit dimensions of the opening in the wall) and disturbance in the reactor thermal dynamic (because heat flow from the shutter is unavoidably different from the wall). Especially significant is thermal disturbance from the shutter in the reactor for high temperature epitaxial deposition (SiC – 1600 C, GaN – 1100 C) where reactor wall are usually water cooled while shutter is not. Because shutter components are logically located approximately on the wafer carrier level, the disturbance from it can have a significant negative effect on the deposition process which is extremely sensitive to uniformity of reactants flow and temperature distribution inside process reactor.

Description of the invention.

Invention is schematically shown (but not limited to) in figure 1. Cylindrical process reactor 2 is made of stainless steel. Reactants are introduced inside reactor 2 through the shower head type water cooled injector flange 1. Water cooled element 6 confine reactants flow to increase deposition efficiency. Wafer carrier 14 with substrates (Si, GaAs, Ge, InP, SiC, sapphire, etc.) for epitaxial deposition can be transferred by special vacuum robot (not shown in figure) through the passthrough 3 with flange 4 connected to gate valve (not shown) that separate reactor environment. Wafer carrier 14 is heated by the radiant heating element(s) 15 which high heating efficiency is provided by three horizontal heat shields 16 and vertical cylindrical heat shield 17. Wafer carrier is supported and spanned by the water cooled spindle 13 sealed from outside by commercially available vacuum rotary feedthrough (in most cases ferrofluidic type) 12 with implemented electrical motor. Process reactor 2 and rotary feedthrough 12 are fixed on water cooled base plate 5.

Passthrough 3 opening is covered by cylindrical shutter 7 with internal cavity for water cooling. Shutter 7 is located on at least two tubing 8 (only one is shown in figure) which is sealed to the reactor based plate 5 using bellow 9. Another end of the tubing 8 is connected to the moveable plate 10 installed using linear motion guide 19 connected through the spacer 20 to the reactor base plate 5. Plate 10 can move up and down by electro-mechanical actuator 11 fixed using stationary plate 18, guide 19, and spacer 20 on the reactor base plate 5. Cooling water is supplied to moveable shutter 7 through the flexible tubing (not shown) connected with the first tube 8, second tube 8 provide for cooling water return.

Movable tubing allows the water cooled shutter 7 to close passthrough 3 opening during epitaxial deposition run. At this time water cooled shutter 7 provides for uniform temperature and flow field around wafer carrier 14 that are required for uniform epitaxial deposition. When deposition run is over, the water cooled shutter 7 is moved down (by force transferred through tubing 8 from electro-mechanical actuator 11) and open passthrough 3 to transfer old carrier 14 from the reactor and new carrier 14 (not shown) in to the reactor.

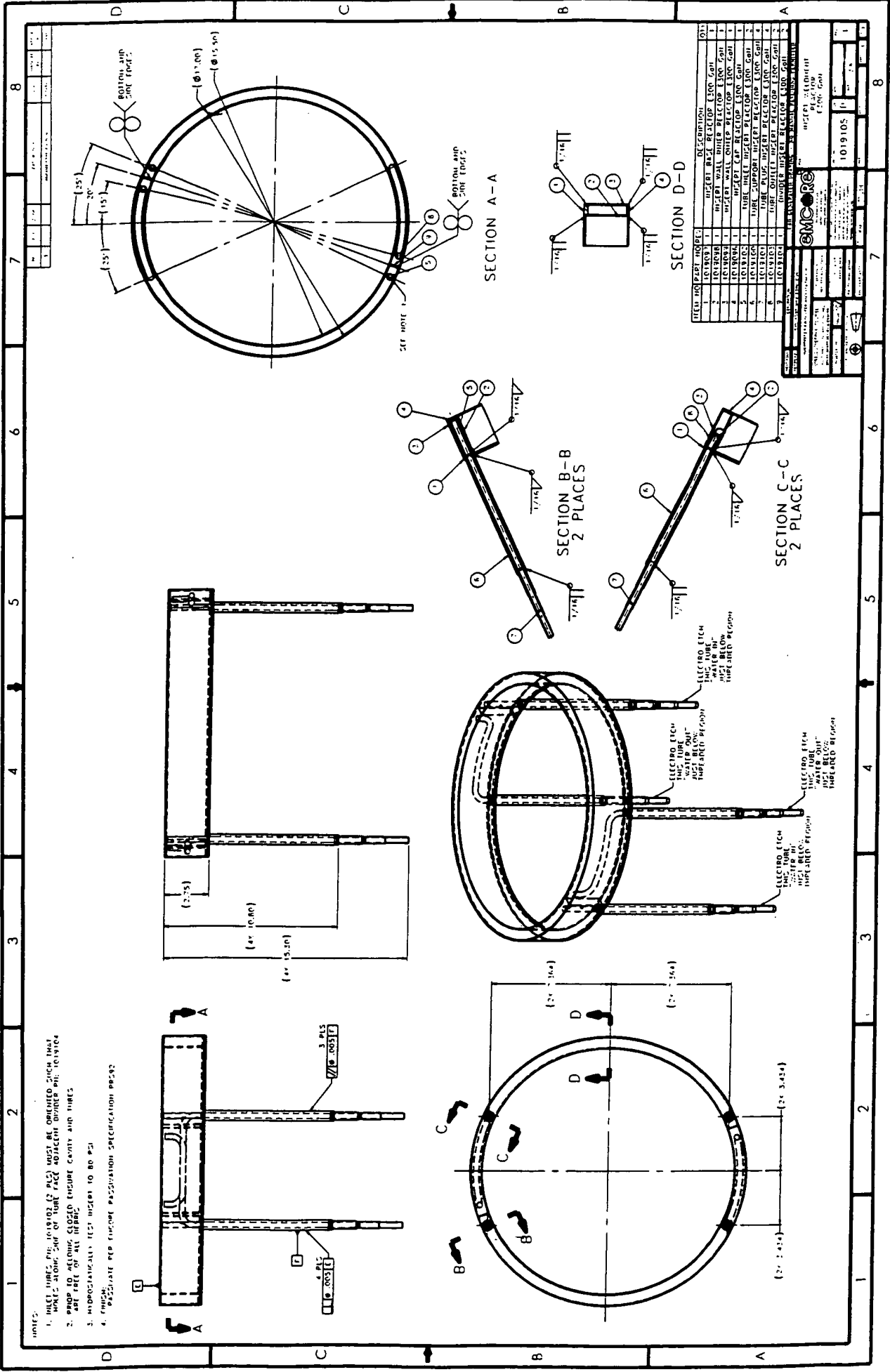
History of the invention:

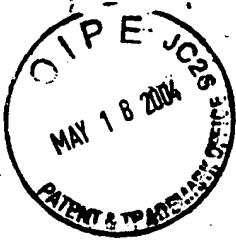
Water cooled cylindrical shutter was independently suggested and implemented by Alex Gurary and Vadim Boguslavskiy in D75 shell reactor on system 6; and by Keng Moy and Scott Elman in E300 GaN system. No system with water cooled cylindrical shutter was sold so far and this design was not presented in papers or on the conferences.

Why we should apply for this invention:

We will protect IP on new important for EMCORE product – E300 GaN system. We strongly believe that successful implementation of this system is largely due to uniform flow and thermal field achieved because of cylindrical water cooled shutter implementation is this system. In future we can expect use such a shutter on new generation of EMCORE's systems.

- NOTES:
1. INLET TUBE, P/N: 1019102 (2 PLS) MUST BE ORIENTED SUCH THAT WORKS ALONG SIDE OF TUBE FACE ADJACENT DOWNER P/N: 1019104
 2. WELD TO AROUND CLOSED INSURE CAVITY AND TUBES
 3. WELD P/N: 1019104
 4. HYDROSTATICALLY TEST INGRESS TO 80 PSI
 5. PASSIVATE AND FINISH PASSIVATION SPECIFICATION 900-92





PATENT
VEECO 3.0-069

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Gurary et al.

Application No. 1C/046,426

Filed: January 15, 2002

For: REACTOR HAVING A MOVABLE
SHUTTER

Group Art Unit: 1763

Examiner: K. Moore

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.131

Sir:

1. I, Vadim Boguslavskiy, am one of the co-inventors with, Alex Gurary, Scott Elman and Keng Moy of the above-identified pending U.S. Patent Application No. 10/046,426, filed in the United States Patent and Trademark Office on January 16, 2002.

2. I was employed by Emcore Corporation, the original assignee of Application No. 10/046,426, as a Staff Engineer during a period from February 1996 through November 2003. In November 2003, the TurboDisc division of Emcore Corporation was purchased by Veeco Instruments Inc. Since that date to the present, I have been employed by Veeco Instruments Inc. as an Engineer.

3. On December 23, 2003, Application No. 10/046,426 was assigned from Encore Corporation to Veeco Instruments Inc. A Patent Assignment for Application No. 10/046,426 was recorded in the United States Patent and Trademark Office at Reel 014242, Frame 0267, on January 8, 2004. A copy of the Patent Assignment is annexed hereto as Exhibit A.

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5. I invented the subject matter of Application No. 10/046,426, including at least one of the claims therein, with Scott Elman, Keng Moy and Vadim Boguslavskiy, and in accordance with our invention, we reduced the invention to practice prior to December 15, 2000

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11. Prior to December 15, 2000, we thus invented and actually reduced to practice a reactor for growing epitaxial layers having a cylindrical shutter with an internal cavity adapted to receive a cooling fluid.

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May 12, 2004
Date

V. Boguslavsky
VADIM BOGUSLAVSKIY

Attachments:

- Exhibit A - Merger Document
- Exhibit B - Imcore Corporation Patent Disclosure
- Exhibit C - Imcore Corporation Print

481133_1.DOC

3.0-069

Docket No.: F53342

FORM PTO-1595 (Modified)
(Rev. 03-01)
OMB No. 0651-0027 (exp. 5/31/2002)
P08/REV03

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U.S. DEPARTMENT OF COMMERCE

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EMCORE Corporation

2. Name and address of receiving party(ies):

Name: **Veeco Instruments Inc.**

Internal Address: _____

Additional names(s) of conveying party(ies)

☒ Yes ☐ No

3. Nature of conveyance:

☒ Assignment

☐ Merger

☐ Security Agreement

☐ Change of Name

☐ Other _____

Street Address: _____

City: **Woodbury** State: **NY** ZIP: **11797**

Execution Date: **December 22, 2003**

Additional name(s) & address(es) attached? ☐ Yes ☒ No

4. Application number(s) or patent numbers(s):

If this document is being filed together with a new application, the execution date of the application is: _____

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5,835,677

6,197,121

Additional numbers attached? ☒ Yes ☐ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: **Phillip Braginsky**

Internal Address: _____

Street Address: _____

City: **Garden City** State: **NY** ZIP: **11530**

6. Total number of applications and patents involved: **22**

7. Total fee (37 CFR 3.41):.....\$ **880.00**

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☒ Authorized to be charged to deposit account

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DO NOT USE THIS SPACE

9. Statement and signature.

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Philip Braginsky, 40,527

Name of Person Signing

Signature

January 8, 2004

Date

Total number of pages including cover sheet, attachments, and document: **6**

Mail documents to be recorded with required cover sheet information to:

Mail Stop Assignment Recordation Services

Director of the United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22304-1450

PATENT

700059763

REEL: 014242 FRAME: 0265

CH \$880.00 191013 09619254

Additional patent numbers:

6,368,404

6,349,270

6,492,625

6,506,252

6,547,876

Patent Assignment

WHEREAS, **EMCORE Corporation** (hereinafter, "Assignor"), a New Jersey corporation with a place of business at 145 Belmont Drive, Somerset, NJ is the owner of rights in certain patents and/or patent applications listed in the attached Schedule, and the inventions disclosed and claimed therein (the "Patents");

WHEREAS, **Veeco Instruments Inc.** (hereinafter, "Assignee"), a corporation organized and existing under the laws of the State of Delaware with offices at 100 Sunnyside Blvd., Suite B, Woodbury, NY 11797-2902, United States of America, desires to acquire Assignor's entire right, title, and interest in and to the Patents; and

WHEREAS, Assignor and Assignee have entered into an Intellectual Property Agreement pursuant to which Assignor has agreed to assign certain proprietary technology, including the Patents, to Assignee.

NOW THEREFORE, effective immediately by this document, and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor does hereby sell, assign and transfer to Assignee, and its successors and assigns, Assignor's entire right, title, and interest, in the United States and all foreign countries, in the Patents, and all continuations, divisions, extensions, reexaminations, reissues, and substitutes thereof, rights of priority under the International Convention for the Protection of Industrial Property, the Inter-American Convention Relating to Patents, Designs and Industrial Models, and any other international agreements to which the United States adheres, and in and to all income, royalties, damages, claims, and payments now or hereafter due or payable with respect thereto, and in and to all causes of action (either in law or in equity) and the right to sue, counterclaim, and recover for past, present, and future infringement of the rights assigned to Assignee hereunder.

Assignor hereby agrees to execute any papers and to perform such other proper acts as reasonably necessary to secure to Assignee or to its successors or assigns, the rights, title and interest hereby transferred.

WHEREFORE, Assignor has duly executed this Patent Assignment on the date indicated below.

("Assignor")

By:



Howard Brodie

Vice President & General Counsel

Date: December 22, 2003

[STATE OF New Jersey]

COUNTY OF Monmouth)

On this 22 day of December 2003 before me, a Notary Public in and for the County of Monmouth in the State of New Jersey, personally appeared Howard Brodie and being duly sworn, averred that, being duly authorized, he executed the foregoing Assignment as his free and voluntary act for the uses and purposes therein set forth.

NOTARY PUBLIC

My Commission Expires: 5/1/2007]

SILVIA GENTILE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires May 1, 2007

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PATENT
REEL: 014242 FRAME: 0268

U.S. Patent No. 6,506,252
Chinese Patent Appln. No. 01822507.1
European Patent Appln. No. 01964250.3
Japanese Patent Appln. No. 2002-562804
Korean Patent Appln. No. 10-2003-7010387

SUSCEPTORLESS REACTOR FOR GROWING
EPITAXIAL LAYERS ON WAFERS BY CVD

U.S. Patent No. 6,547,876

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS BY CHEMICAL VAPOR
DEPOSITION

U.S. Patent Appln. No. 09/619,254
European Patent Appln. No. 00952166.7
Japanese Patent Appln. No. 512955/2001
Korean Patent Appln. No. 2002-701052
Taiwan Patent No. NI-154647

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS USING LOW PRESSURE
INTERFACE AND METHODS THEREOF

U.S. Patent Appln. No. 10/046,426

REACTOR HAVING A MOVABLE SHUTTER

U.S. Patent Appln. No. 10/304,646
U.S. Patent Appln. No. 10/268,464

SUSCEPTORLESS REACTOR FOR GROWING
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APPARATUS FOR GROWING EPITAXIAL
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U.S. Provisional Appln. No. 60/514,959

WAFER CARRIER FOR GROWING GaN
WAFERS

PCT/US03/26112
Taiwan Patent Appln. No. 092125071

ALKYL PUSH FLOW FOR VERTICAL FLOW
ROTATING DISK REACTORS

N/A

METHOD AND DEVICE FOR WAFER AND
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Patent Schedule

U.S. Patent No. 4,714,091
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U.S. Patent No. 4,969,416

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U.S. Patent No. 5,336,324
U.S. Patent No. 5,544,618

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ON A SUBSTRATE

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CVD REACTOR FOR UNIFORM HEATING
WITH RADIANT HEATING ELEMENTS

U.S. Patent No. 5,835,677
U.S. Patent No. 5,835,678

LIQUID VAPORIZER SYSTEM AND METHOD

U.S. Patent No. 6,001,183

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U.S. Patent No. 6,080,241

CHEMICAL VAPOR DEPOSITIONS CHAMBER
HAVING AN ADJUSTABLE FLOW FLANGE

U.S. Patent No. 6,197,121

CHEMICAL VAPOR DEPOSITION
APPARATUS

U.S. Patent No. 6,368,404

INDUCTION HEATING CHEMICAL VAPOR
DEPOSITION REACTOR

U.S. Patent No. 6,349,270

METHOD AND APPARATUS FOR
MEASURING THE TEMPERATURE OF
OBJECTS ON A FAST MOVING HOLDER

U.S. Patent No. 6,492,625
Chinese Patent Appln. No. 01819511.3
European Patent Appln. No. 01957492.0
Japanese Patent Appln. No. 2002-530254
Korean Patent Appln. No. 10-2003-7003837

APPARATUS AND METHOD FOR
CONTROLLING TEMPERATURE
UNIFORMITY OF SUBSTRATES

H:\work\1714\T53342\Misc\Patent Schedule.doc

PATENT
REEL: 014242 FRAME: 0269

REACTOR FOR HIGH TEMPERATURE EPITAXIAL DEPOSITION

EMCORE Corporation, 145 Belmont Drive, Somerset, NJ 08873

Authors: Keng Moy, Scott Elman, Vadim Boguslavskiy, Alex Gurary

PATENT DISCLOSURE

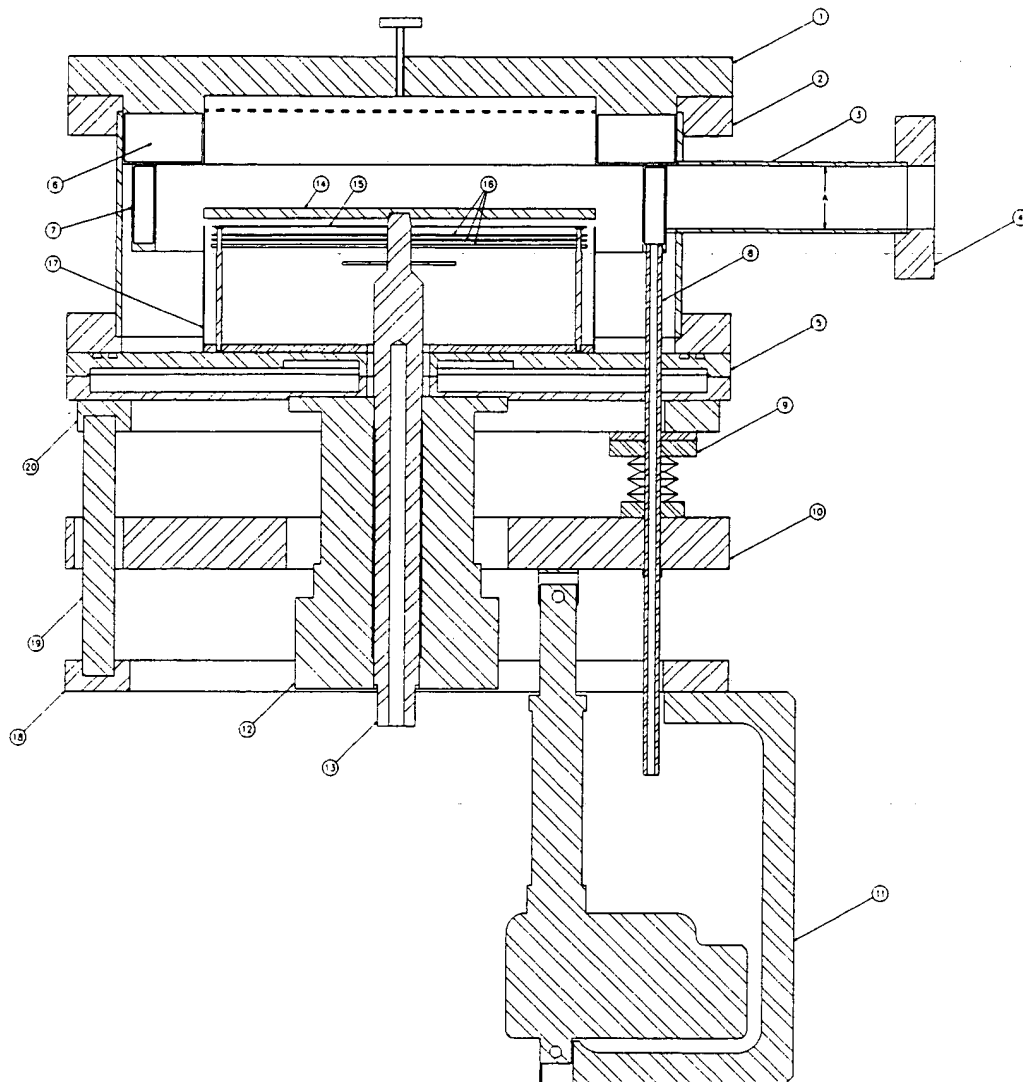


Figure 1. Schematics of the reactor for high temperature epitaxial deposition

Abstract.

Object of the invention is a reactor for high temperature epitaxial deposition with mechanism for wafer carrier transfer in and out reactor which do not produce disturbance in the axisymmetric uniformity of thermal and flow field inside reactor and, hence, provides for extremely uniform epitaxial deposition. Invention is applicable preferably to axisymmetric reactor for epitaxial deposition of SiC (1600 C) and GaN (1100 C). Additionally invention is applicable for epitaxial reactor based on the high speed vertical rotating disk technology.

Background of the invention.

Most of production level epitaxial deposition reactors have a cylindrical shape with opening on the side wall to transfer wafer carriers in and out of the reactor. Opening on the side is connected through the gate valve with load lock which allows the reactor to be open each run while maintaining a low level of contamination in the reactor environment required for the advanced epitaxial deposition. During the deposition run the opening on the wall is covered by the special movable shutter with surface larger than opening to prevent gate valve overheating and particles formation. Unfortunately shutter also provides disturbance in the process flow dynamic (because to provide its movement shutter could not perfectly fit dimensions of the opening in the wall) and disturbance in the reactor thermal dynamic (because heat flow from the shutter is unavoidably different from the wall). Especially significant is thermal disturbance from the shutter in the reactor for high temperature epitaxial deposition (SiC – 1600 C, GaN – 1100 C) where reactor wall are usually water cooled while shutter is not. Because shutter components are logically located approximately on the wafer carrier level, the disturbance from it can have a significant negative effect on the deposition process which is extremely sensitive to uniformity of reactants flow and temperature distribution inside process reactor.

Description of the invention.

Invention is schematically shown (but not limited to) in figure 1. Cylindrical process reactor 2 is made of stainless steel. Reactants are introduced inside reactor 2 through the shower head type water cooled injector flange 1. Water cooled element 6 confine reactants flow to increase deposition efficiency. Wafer carrier 14 with substrates (Si, GaAs, Ge, InP, SiC, sapphire, etc.) for epitaxial deposition can be transferred by special vacuum robot (not shown in figure) through the passthrough 3 with flange 4 connected to gate valve (not shown) that separate reactor environment. Wafer carrier 14 is heated by the radiant heating element(s) 15 which high heating efficiency is provided by three horizontal heat shields 16 and vertical cylindrical heat shield 17. Wafer carrier is supported and spanned by the water cooled spindle 13 sealed from outside by commercially available vacuum rotary feedthrough (in most cases ferrofluidic type) 12 with implemented electrical motor. Process reactor 2 and rotary feedthrough 12 are fixed on water cooled base plate 5.

Passthrough 3 opening is covered by cylindrical shutter 7 with internal cavity for water cooling. Shutter 7 is located on at least two tubing 8 (only one is shown in figure) which is sealed to the reactor based plate 5 using bellow 9. Another end of the tubing 8 is connected to the moveable plate 10 installed using linear motion guide 19 connected through the spacer 20 to the reactor base plate 5. Plate 10 can move up and down by electro-mechanical actuator 11 fixed using stationary plate 18, guide 19, and spacer 20 on the reactor base plate 5. Cooling water is supplied to moveable shutter 7 through the flexible tubing (not shown) connected with the first tube 8, second tube 8 provide for cooling water return.

Movable tubing allows the water cooled shutter 7 to close passthrough 3 opening during epitaxial deposition run. At this time water cooled shutter 7 provides for uniform temperature and flow field around wafer carrier 14 that are required for uniform epitaxial deposition. When deposition run is over, the water cooled shutter 7 is moved down (by force transferred through tubing 8 from electro-mechanical actuator 11) and open passthrough 3 to transfer old carrier 14 from the reactor and new carrier 14 (not shown) in to the reactor.

History of the invention:

Water cooled cylindrical shutter was independently suggested and implemented by Alex Gurary and Vadim Boguslavskiy in D75 shell reactor on system 6; and by Keng Moy and Scott Elman in E300 GaN system. No system with water cooled cylindrical shutter was sold so far and this design was not presented in papers or on the conferences.

Why we should apply for this invention:

We will protect IP on new important for EMCORE product – E300 GaN system. We strongly believe that successful implementation of this system is largely due to uniform flow and thermal field achieved because of cylindrical water cooled shutter implementation is this system. In future we can expect use such a shutter on new generation of EMCORE's systems.



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. 13/C46,426

Filed: January 16, 2002

For: REACTOR HAVING A MOVABLE
SHUTTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.131

Sir:

1. I, Scott Elman, am one of the co-inventors with, Alex Gurary, Keng Moy and Vadim Boguslavskiy of the above-identified pending U.S. Patent Application No. 10/046,426, filed in the United States Patent and Trademark Office on January 16, 2002.

2. I was employed by Emcore Corporation, the original assignee of Application No. 10/046,426, as a Mechanical Designer during a period from April 1991 through November 2003. In November 2003, the TurboDisc division of Emcore Corporation was purchased by Veeco Instruments Inc. Since that date to the present, I have been employed by Veeco Instruments Inc. as a Mechanical Design Engineer.

3. On December 23, 2003, Application No. 10/046,426 was assigned from Emcore Corporation to Veeco Instruments Inc. A Patent Assignment for Application No. 10/046,426 was recorded in the United States Patent and Trademark Office at Reel 014242, Frame 0267, on January 8, 2004. A copy of the Patent Assignment is annexed hereto as Exhibit A.

4. I am aware that Application No. 10/046,426 claims benefit of U.S. Provisional Application Ser. No. 60/296,598, filed June 7, 2000.

5. I invented the subject matter of Application No. 10/046,426, including at least one of the claims therein, with Scott Elman, Keng Moy and Vadim Boguslavskiy, and in accordance with our invention, we reduced the invention to practice prior to December 15, 2000.

6. I am familiar with the prosecution of Application No. 10/046,426, including the Office Action mailed December 16, 2003. In particular, this Office Action includes a rejection based in part upon U.S. Patent Application Publication No. U.S. 2002/0076490 to Chiang et al. (the '490 published application) and U.S. Patent No. 6,442,950 to Tung (the '950 patent).

7. I make this Declaration under 37 C.F.R. § 1.131 in order to present a showing of facts establishing a reduction to practice of the invention claimed in Application No. 10/046,426 in this country prior to December 15, 2000, which is the earliest effective filing date of the '490 published application.

8. All of the facts described herein took place in the United States.

9. Annexed hereto is Exhibit B, which is a true copy of an Emcore Patent Disclosure, the date of which has been redacted, but which predates December 15, 2000. The disclosure details a reactor for epitaxial deposition having a cylindrical shutter with an internal cavity for receiving a coolant, which discloses each and every feature of the reactor as claimed in at least one pending claim of Application No. 10/046,426. As set forth in the patent disclosure, my invention is described as a reactor for growing epitaxial layers including an airtight reaction chamber having a passthrough opening for inserting and removing wafer carriers from the reaction chamber, and a cylindrical shutter located inside the reaction chamber for selectively closing the passthrough opening, the cylindrical shutter being movable between a first position for closing the passthrough opening and a second position for opening the passthrough opening, whereby the cylindrical shutter has an internal cavity adapted to receive a cooling fluid.

10. Annexed hereto is Exhibit C, which is a true copy of an Emcore print, the date of which has been redacted, but which predates December 15, 2000. The print details a cylindrical shutter having an internal cavity for receiving a coolant.

11. Prior to December 15, 2000, we thus invented and actually reduced to practice a reactor for growing epitaxial layers having a cylindrical shutter with an internal cavity adapted to receive a cooling fluid.

12. It is submitted that the foregoing presentation of facts and supporting documentation establishes the completion of Applicants' claimed invention and that such completion predates December 15, 2000.

13. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

5/12/04

Date


SCOTT ELMAN

Attachments:

- Exhibit A - Merger Document
- Exhibit B - Emcore Corporation Patent Disclosure
- Exhibit C - Emcore Corporation Print

Additional patent numbers:

6,368,404

6,349,270

6,492,625

6,506,252

6,547,876

3.0-069

Docket No.: F53342

FORM PTO-1595 (Modified)
(Rev. 03-01)
OMB No. 0561-0027 (exp. 5/31/2002)
P08/REV03

RECORDATION FORM COVER SHEET

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

PATENTS ONLY

Tab settings → → → ▼ ▼ ▼ ▼ ▼ ▼ ▼

To the Director of the United States Patent and Trademark Office: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
EMCORE Corporation

2. Name and address of receiving party(ies):

Name: **Veeco Instruments Inc.**

Internal Address: _____

Street Address: _____

City: **Woodbury** State: **NY** ZIP: **11797**Additional name(s) & address(es) attached? ☐ Yes ☒ No

Additional names(s) of conveying party(ies)

☒ Yes ☐ No

3. Nature of conveyance:

☒ Assignment☐ Merger☐ Security Agreement☐ Change of Name☐ Other _____Execution Date: **December 22, 2003**

4. Application number(s) or patent numbers(s):

If this document is being filed together with a new application, the execution date of the application is: _____

A. Patent Application No.(s)

B. Patent No.(s)

09/619,254 60/514,959
10/046,426
10/304,646
10/268,464

4,714,091	5,336,324	5,835,678
4,772,356	5,544,618	6,001,183
4,838,983	5,759,281	6,080,241
4,969,416	5,835,677	6,197,121

Additional numbers attached? ☒ Yes ☐ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: **Philip Braginsky**

Internal Address: _____

Street Address: _____

City: **Garden City** State: **NY** ZIP: **11530**6. Total number of applications and patents involved: **22**7. Total fee (37 CFR 3.41):.....\$ **880.00**☐ Enclosed - Any excess or insufficiency should be credited or debited to deposit account☒ Authorized to be charged to deposit account

8. Deposit account number:

19-1013

(Attach duplicate copy of this page if paying by deposit account)

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9. Statement and signature.

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Philip Braginsky, 40,527

Name of Person Signing

Signature

January 8, 2004

Date

Total number of pages including cover sheet, attachments, and document: **6**

Mail documents to be recorded with required cover sheet information to:
Mail Stop Assignment Recordation Services

PATENT

700059763

Director of the United States Patent and Trademark Office, P.O. Box 1450

REEL: 014242 FRAME: 0265

CH \$880.00 191013 09619254

Patent Assignment

WHEREAS, EMCORE Corporation (hereinafter, "Assignor"), a New Jersey corporation with a place of business at 145 Belmont Drive, Somerset, NJ is the owner of rights in certain patents and/or patent applications listed in the attached Schedule, and the inventions disclosed and claimed therein (the "Patents");

WHEREAS, Veeco Instruments Inc. (hereinafter, "Assignee"), a corporation organized and existing under the laws of the State of Delaware with offices at 100 Sunnyside Blvd., Suite B, Woodbury, NY 11797-2902, United States of America, desires to acquire Assignor's entire right, title, and interest in and to the Patents; and

WHEREAS, Assignor and Assignee have entered into an Intellectual Property Agreement pursuant to which Assignor has agreed to assign certain proprietary technology, including the Patents, to Assignee.

NOW THEREFORE, effective immediately by this document, and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor does hereby sell, assign and transfer to Assignee, and its successors and assigns, Assignor's entire right, title, and interest, in the United States and all foreign countries, in the Patents, and all continuations, divisions, extensions, reexaminations, reissues, and substitutes thereof, rights of priority under the International Convention for the Protection of Industrial Property, the Inter-American Convention Relating to Patents, Designs and Industrial Models, and any other international agreements to which the United States adheres, and in and to all income, royalties, damages, claims, and payments now or hereafter due or payable with respect thereto, and in and to all causes of action (either in law or in equity) and the right to sue, counterclaim, and recover for past, present, and future infringement of the rights assigned to Assignee hereunder.

Assignor hereby agrees to execute any papers and to perform such other proper acts as reasonably necessary to secure to Assignee or to its successors or assigns, the rights, title and interest hereby transferred.

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PATENT
REEL: 014242 FRAME: 0267

WHEREFORE, Assignor has duly executed this Patent Assignment on the date indicated below.

("Assignor")

By:



Hazare Brodie
Vice President & General Counsel

Date: December 22, 2003

[STATE OF New Jersey)

COUNTY OF Monmouth)

On this 22 day of December 2003 before me, a Notary Public in and for the County of Monmouth in the State of New Jersey, personally appeared Hazare Brodie, and being duly sworn, averred that, being duly authorized, he executed the foregoing Assignment as his free and voluntary act for the uses and purposes therein set forth.

NOTARY PUBLIC

My Commission Expires: 5/1/2007]

SILVIA GENTILE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires May 1, 2007

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PATENT
REEL: 014242 FRAME: 0268

U.S. Patent No. 6,506,252
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APPARATUS AND METHOD FOR
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PATENT
REEL: 014242 FRAME: 0269

REACTOR FOR HIGH TEMPERATURE EPITAXIAL DEPOSITION

EMCORE Corporation, 145 Belmont Drive, Somerset, NJ 08873

Authors: Keng Moy, Scott Elman, Vadim Boguslavskiy, Alex Gurary

PATENT DISCLOSURE

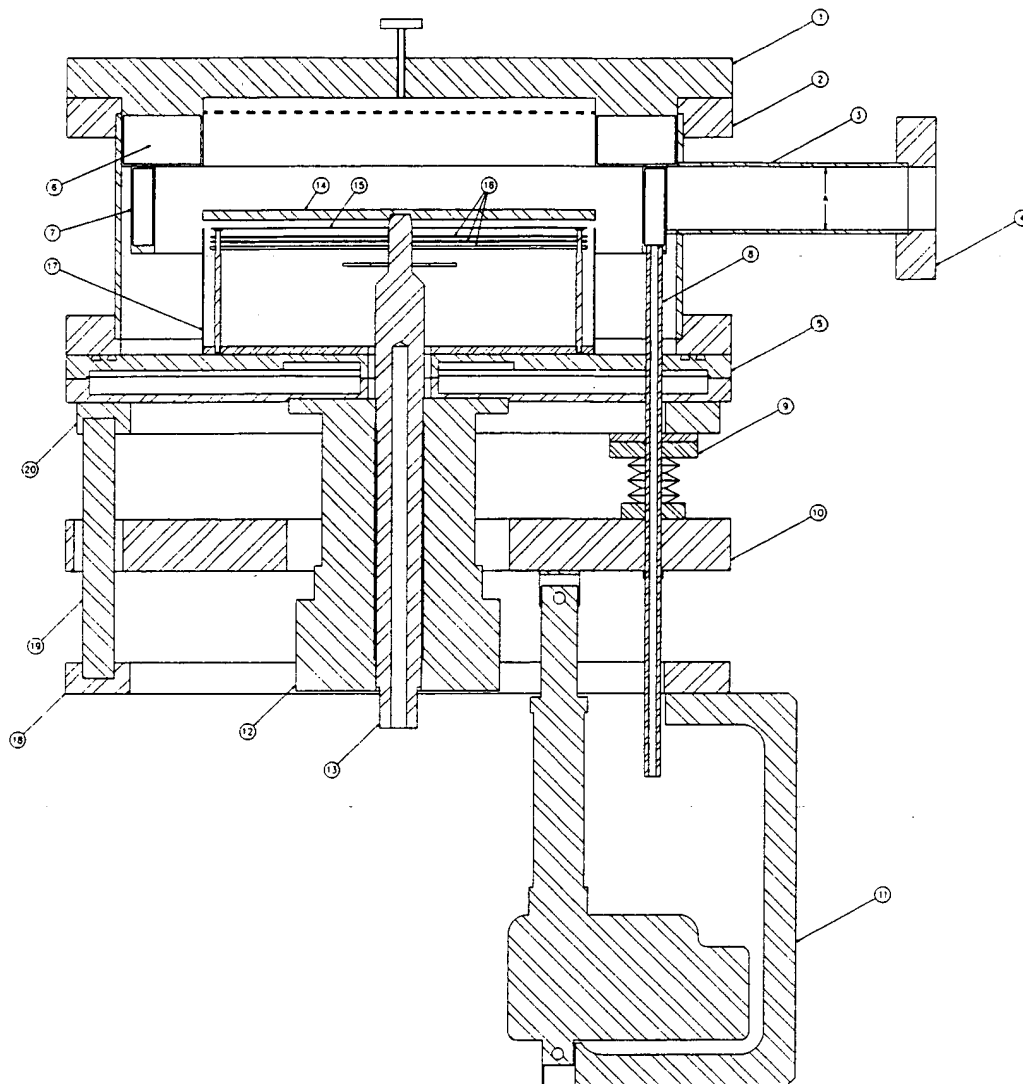


Figure 1. Schematics of the reactor for high temperature epitaxial deposition

Abstract.

Object of the invention is a reactor for high temperature epitaxial deposition with mechanism for wafer carrier transfer in and out reactor which do not produce disturbance in the axisymmetric uniformity of thermal and flow field inside reactor and, hence, provides for extremely uniform epitaxial deposition. Invention is applicable preferably to axisymmetric reactor for epitaxial deposition of SiC (1600 C) and GaN (1100 C). Additionally invention is applicable for epitaxial reactor based on the high speed vertical rotating disk technology.

Background of the invention.

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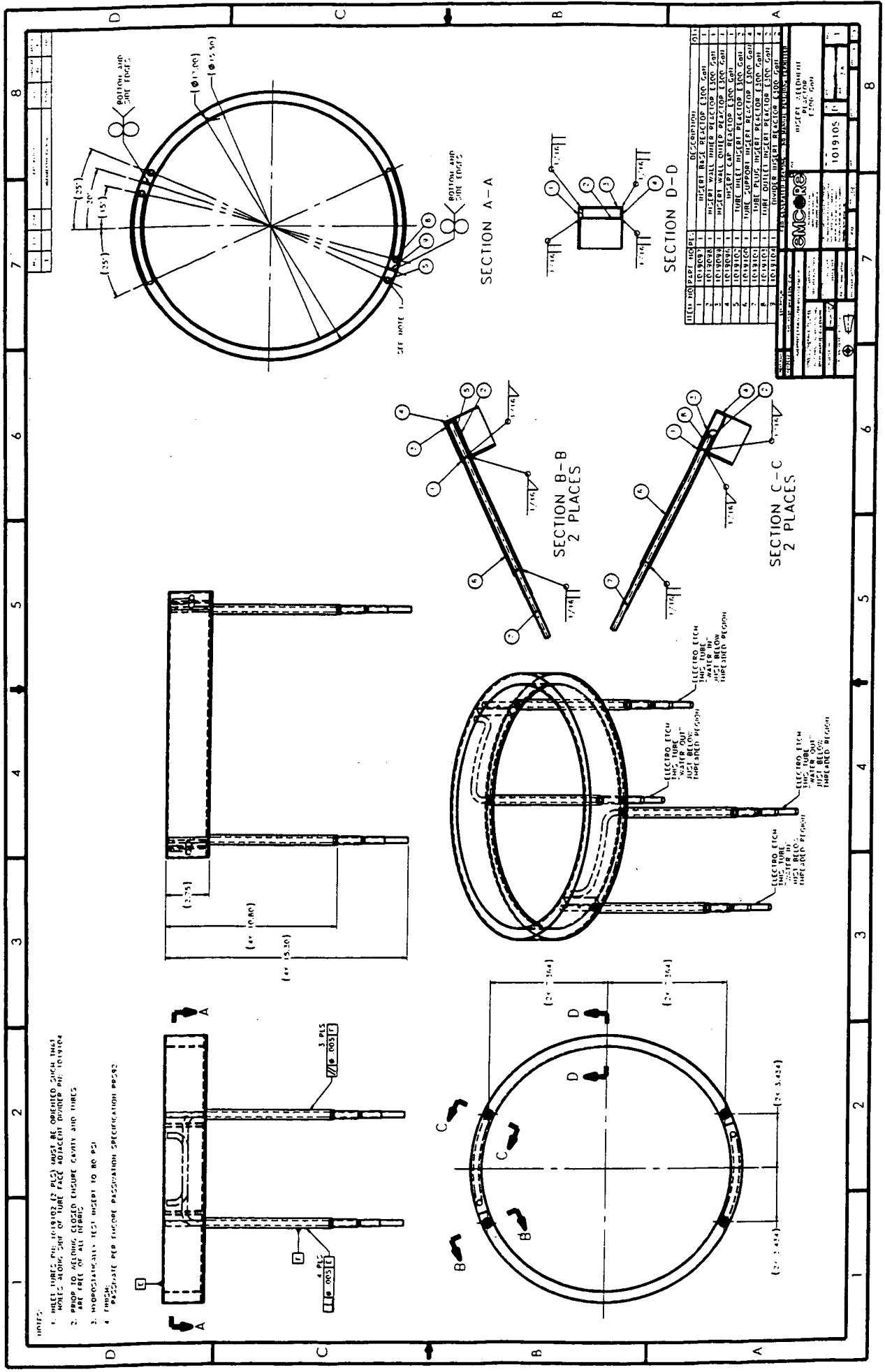
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History of the invention:

Water cooled cylindrical shutter was independently suggested and implemented by Alex Gurary and Vadim Boguslavskiy in D75 shell reactor on system 6; and by Keng Moy and Scott Elman in E300 GaN system. No system with water cooled cylindrical shutter was sold so far and this design was not presented in papers or on the conferences.

Why we should apply for this invention:

We will protect IP on new important for EMCORE product – E300 GaN system. We strongly believe that successful implementation of this system is largely due to uniform flow and thermal field achieved because of cylindrical water cooled shutter implementation in this system. In future we can expect use such a shutter on new generation of EMCORE's systems.



- NOTES:
1. INLET TUBE, P/N 1019102 (2 PL) MUST BE ORIENTED SUCH THAT WORKS ALONG SUR OF TUBE FACE ADJACENT TO INLET TUBE.
 2. PRIOR TO WELDING CLOSED ENSURE CAVITY AND TUBES ARE FREE OF ALL DEBRIS.
 3. HYDROSTATICALLY TEST INLET TO NO. 2.
 4. FINISH: PASSIVATE PER INCOME PASSIVATION SPECIFICATION #9582.



PATENT
VEECO 3.0-069

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Gurary et al.

Application No. 10/046,426

Filed: January 16, 2002

For: REACTOR HAVING A MOVABLE SHUTTER

Group Art Unit: 1763

Examiner: K. Moore

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.131

Sir:

1. I, Keng Moy, am one of the co-inventors with, Alex Gurary, Scott Elman and Vadim Boguslavskiy of the above-identified pending U.S. Patent Application No. 10/046,426, filed in the United States Patent and Trademark Office on January 16, 2002.

2. I was employed by Emcore Corporation, the original assignee of Application No. 10/046,426, as an Engineer during a period from May 1989 through November 2003. In November 2003, the TurboDisc division of Emcore Corporation was purchased by Veeco Instruments Inc. Since that date to the present, I have been employed by Veeco Instruments Inc. as an Engineer.

3. On December 23, 2003, Application No. 10/046,426 was assigned from Emcore Corporation to Veeco Instruments Inc. A

Patent Assignment for Application No. 10/046,426 was recorded in the United States Patent and Trademark Office at Reel 014242, Frame 0267, on January 8, 2004. A copy of the Patent Assignment is annexed hereto as Exhibit A.

4. I am aware that Application No. 10/046,426 claims benefit of U.S. Provisional Application Ser. No. 60/296,598, filed June 7, 2000..

5. I invented the subject matter of Application No. 10/046,426, including at least one of the claims therein, with Scott Elman, Keng Moy and Vadim Boguslavskiy, and in accordance with our invention, we reduced the invention to practice prior to December 15, 2000.

6. I am familiar with the prosecution of Application No. 10/046,426, including the Office Action mailed December 16, 2003. In particular, this Office Action includes a rejection based in part upon U.S. Patent Application Publication No. U.S. 2002/0076490 to Chiang et al. (the '490 published application) and U.S. Patent No. 5,442,950 to Tung (the '950 patent).

7. I make this Declaration under 37 C.F.R. § 1.131 in order to present a showing of facts establishing a reduction to practice of the invention claimed in Application No. 10/046,426 in this country prior to December 15, 2000, which is the earliest effective filing date of the '490 published application.

8. All of the facts described herein took place in the United States

9. Annexed hereto is Exhibit B, which is a true copy of an Emcore Patent Disclosure, the date of which has been redacted, but which predates December 15, 2000. The disclosure details a reactor for epitaxial deposition having a cylindrical shutter with an internal cavity for receiving a coolant, which discloses each and every feature of the reactor as claimed in at least one pending claim of Application No. 10/046,426. As set forth in the patent disclosure, my invention is described as a reactor for growing epitaxial layers including an airtight reaction chamber having a passthrough opening for inserting and removing wafer carriers from the reaction chamber, and a cylindrical shutter located inside the reaction chamber for selectively closing the passthrough opening, the cylindrical shutter being movable between a first position for closing the passthrough opening and a second position for opening the passthrough opening, whereby the cylindrical shutter has an internal cavity adapted to receive a cooling fluid.

10. Annexed hereto is Exhibit C, which is a true copy of an Emcore print the date of which has been redacted, but which predates December 15, 2000. The print details a cylindrical shutter having an internal cavity for receiving a coolant.

11. Prior to December 15, 2000, we thus invented and actually reduced to practice a reactor for growing epitaxial

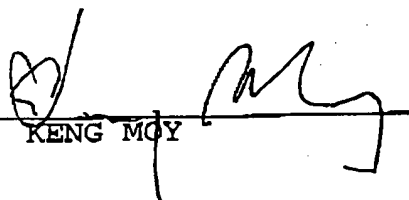
layers having a cylindrical shutter with an internal cavity adapted to receive a cooling fluid.

12. It is submitted that the foregoing presentation of facts and supporting documentation establishes the completion of Applicants' claimed invention and that such completion predates December 15, 2000.

13. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

5/12/2004

Date


KENG MOY

Attachments:

- Exhibit A - Merger Document
- Exhibit B - Encore Corporation Patent Disclosure
- Exhibit C - Encore Corporation Print

481132_1.DOC

3.0-069

Docket No.: F53342

FORM PTO-1595 (Modified)
(Rev. 03-01)
OMB No. 0551-0027 (exp. 3/31/2002)
P08/REV03

RECORDATION FORM COVER SHEET

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

PATENTS ONLY

Tab settings → → → ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼

To the Director of the United States Patent and Trademark Office: Please record the attached original documents or copy thereof.

1. Name of conveying party(ies):
EMCORE Corporation

2. Name and address of receiving party(ies):

Name: **Veeco Instruments Inc.**

Internal Address: _____

Street Address: _____

City: **Woodbury** State: **NY** ZIP: **11797**Additional name(s) & address(es) attached? ☐ Yes ☒ No

Additional names(s) of conveying party(ies)

☒ Yes ☐ No

3. Nature of conveyance:

☒ Assignment☐ Merger☐ Security Agreement☐ Change of Name☐ Other _____Execution Date: **December 22, 2003**

4. Application number(s) or patent numbers(s):

If this document is being filed together with a new application, the execution date of the application is: _____

A. Patent Application No.(s)

09/619,254

60/514,959

10/046,426

10/304,646

10/268,464

B. Patent No.(s)

4,714,091

5,336,324

5,835,678

4,772,356

5,544,618

6,001,183

4,838,983

5,759,281

6,080,241

4,969,416

5,835,677

6,197,121

Additional numbers attached? ☒ Yes ☐ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: **Phillip Braginsky**

Internal Address: _____

Street Address: _____

City: **Garden City**State: **NY**ZIP: **11530**6. Total number of applications and patents involved: **22**7. Total fee (37 CFR 3.41):\$ **880.00**☐ Enclosed - Any excess or insufficiency should be credited or debited to deposit account☒ Authorized to be charged to deposit account

8. Deposit account number:

19-1013

(Attach duplicate copy of this page if paying by deposit account)

DO NOT USE THIS SPACE

9. Statement and signature.

To the best of my knowledge and belief, the foregoing information is true and correct and any attached copy is a true copy of the original document.

Phillip Braginsky, 40,527

Name of Person Signing

Signature

January 8, 2004

Date

Total number of pages including cover sheet, attachments, and document: **6**

Mail documents to be recorded with required cover sheet information to:

Mail Stop Assignment Recordation Services

PATENT

700059763

Director of the United States Patent and Trademark Office, P.O. Box 1450

REEL: 014242 FRAME: 0265

CH \$880.00 191013 09619254

Patent Assignment

WHEREAS, EMCORE Corporation (hereinafter, "Assignor"), a New Jersey corporation with a place of business at 145 Belmont Drive, Somerset, NJ is the owner of rights in certain patents and/or patent applications listed in the attached Schedule, and the inventions disclosed and claimed therein (the "Patents");

WHEREAS, Veeco Instruments Inc. (hereinafter, "Assignee"), a corporation organized and existing under the laws of the State of Delaware with offices at 100 Sunnyside Blvd., Suite B, Woodbury, NY 11797-2902, United States of America, desires to acquire Assignor's entire right, title, and interest in and to the Patents; and

WHEREAS, Assignor and Assignee have entered into an Intellectual Property Agreement pursuant to which Assignor has agreed to assign certain proprietary technology, including the Patents, to Assignee.

NOW THEREFORE, effective immediately by this document, and for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor does hereby sell, assign and transfer to Assignee, and its successors and assigns, Assignor's entire right, title, and interest, in the United States and all foreign countries, in the Patents, and all continuations, divisions, extensions, reexaminations, reissues, and substitutes thereof, rights of priority under the International Convention for the Protection of Industrial Property, the Inter-American Convention Relating to Patents, Designs and Industrial Models, and any other international agreements to which the United States adheres, and in and to all income, royalties, damages, claims, and payments now or hereafter due or payable with respect thereto, and in and to all causes of action (either in law or in equity) and the right to sue, counterclaim, and recover for past, present, and future infringement of the rights assigned to Assignee hereunder.

Assignor hereby agrees to execute any papers and to perform such other proper acts as reasonably necessary to secure to Assignee or to its successors or assigns, the rights, title and interest hereby transferred.

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PATENT
REEL: 014242 FRAME: 0267

WHEREFORE, Assignor has duly executed this Patent Assignment on the date indicated below.

("Assignor")

By:



Howard Brodie
Vice President & General Counsel

Date: December 22, 2003

[STATE OF New Jersey]

COUNTY OF Monmouth)

On this 22 day of December 2003 before me, a Notary Public in and for
Monmouth in the State of New Jersey, personally appeared
brodie and being duly sworn, averred that, being duly authorized, he executed the
foregoing Assignment as his free and voluntary act for the uses and purposes therein set
forth.

NOTARY PUBLIC

My Commission Expires: 5/1/2007]

SILVIA GENTILE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires May 1, 2007

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PATENT
REEL: 014242 FRAME: 0268

U.S. Patent No. 6,506,252
Chinese Patent Appln. No. 01822507.1
European Patent Appln. No. 01964250.3
Japanese Patent Appln. No. 2002-562804
Korean Patent Appln. No. 10-2003-7010387

SUSCEPTORLESS REACTOR FOR GROWING
EPITAXIAL LAYERS ON WAFERS BY CVD

U.S. Patent No. 6,547,876

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS BY CHEMICAL VAPOR
DEPOSITION

U.S. Patent Appln. No. 09/619,254
European Patent Appln. No. 00952166.7
Japanese Patent Appln. No. 512955/2001
Korean Patent Appln. No. 2002-701052
Taiwan Patent No. NI-154647

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS USING LOW PRESSURE
INTERFACE AND METHODS THEREOF

U.S. Patent Appln. No. 10/046,426

REACTOR HAVING A MOVABLE SHUTTER

U.S. Patent Appln. No. 10/304,646
U.S. Patent Appln. No. 10/268,464

SUSCEPTORLESS REACTOR FOR GROWING
EPITAXIAL LAYERS ON WAFERS BY
CHEMICAL VAPOR DEPOSITION

U.S. Patent Appln. No. 09/619,254

APPARATUS FOR GROWING EPITAXIAL
LAYERS ON WAFERS USING LOW PRESSURE
INTERFACE AND METHODS THEREFOR

U.S. Provisional Appln. No. 60/514,959

WAFER CARRIER FOR GROWING GaN
WAFERS

PCT/US03/26112
Taiwan Patent Appln. No. 092125071

ALKYL PUSH FLOW FOR VERTICAL FLOW
ROTATING DISK REACTORS

N/A

METHOD AND DEVICE FOR WAFER AND
CARRIER CONTROL DURING MOCVD OF
GaN RELATED MATERIALS

Patent Schedule

U.S. Patent No. 4,714,091
Japanese Patent No. 1758220

MODULAR GAS HANDLING APPARATUS

U.S. Patent No. 4,772,356
U.S. Patent No. 4,838,983
U.S. Patent No. 4,969,416

GAS TREATMENT APPARATUS AND METHOD

U.S. Patent No. 5,336,324
U.S. Patent No. 5,544,618

APPARATUS FOR DEPOSITING A COATING
ON A SUBSTRATE

U.S. Patent No. 5,759,281

CVD REACTOR FOR UNIFORM HEATING
WITH RADIANT HEATING ELEMENTS

U.S. Patent No. 5,835,677
U.S. Patent No. 5,835,678

LIQUID VAPORIZER SYSTEM AND METHOD

U.S. Patent No. 6,001,183

WAFER CARRIERS FOR EPITAXIAL
GROWTH PROCESSES

U.S. Patent No. 6,080,241

CHEMICAL VAPOR DEPOSITIONS CHAMBER
HAVING AN ADJUSTABLE FLOW FLANGE

U.S. Patent No. 6,197,121

CHEMICAL VAPOR DEPOSITION
APPARATUS

U.S. Patent No. 6,368,404

INDUCTION HEATING CHEMICAL VAPOR
DEPOSITION REACTOR

U.S. Patent No. 6,349,270

METHOD AND APPARATUS FOR
MEASURING THE TEMPERATURE OF
OBJECTS ON A FAST MOVING HOLDER

U.S. Patent No. 6,492,625
Chinese Patent Appln. No. 01819511.3
European Patent Appln. No. 01957492.0
Japanese Patent Appln. No. 2002-530254
Korean Patent Appln. No. 10-2003-7003837

APPARATUS AND METHOD FOR
CONTROLLING TEMPERATURE
UNIFORMITY OF SUBSTRATES

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PATENT
REEL: 014242 FRAME: 0269

REACTOR FOR HIGH TEMPERATURE EPITAXIAL DEPOSITION

EMCORE Corporation, 145 Belmont Drive, Somerset, NJ 08873

Authors: Keng Moy, Scott Elman, Vadim Boguslavskiy, Alex Gurary

PATENT DISCLOSURE

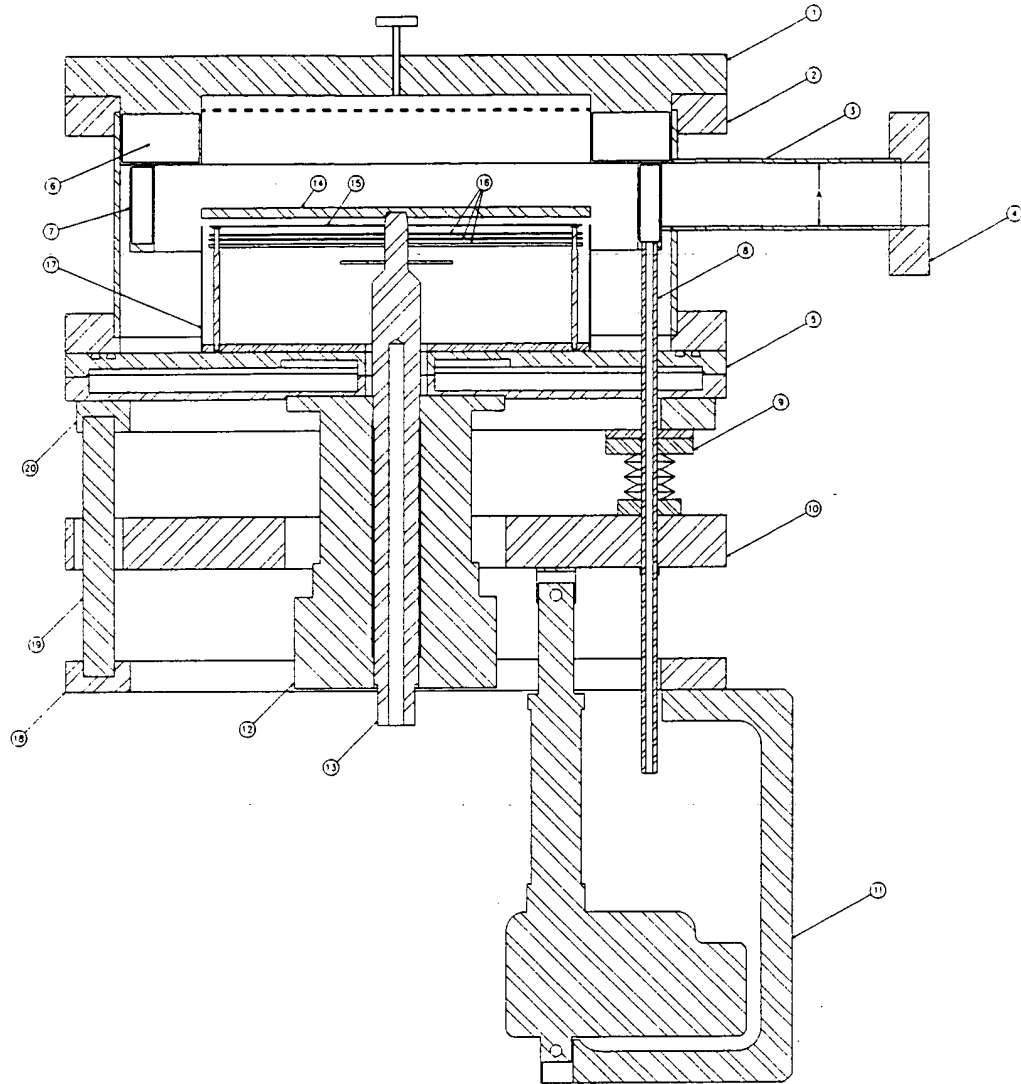


Figure 1. Schematics of the reactor for high temperature epitaxial deposition

Abstract.

Object of the invention is a reactor for high temperature epitaxial deposition with mechanism for wafer carrier transfer in and out reactor which do not produce disturbance in the axisymmetric uniformity of thermal and flow field inside reactor and, hence, provides for extremely uniform epitaxial deposition. Invention is applicable preferably to axisymmetric reactor for epitaxial deposition of SiC (1600 C) and GaN (1100 C). Additionally invention is applicable for epitaxial reactor based on the high speed vertical rotating disk technology.

Background of the invention.

Most of production level epitaxial deposition reactors have a cylindrical shape with opening on the side wall to transfer wafer carriers in and out of the reactor. Opening on the side is connected through the gate valve with load lock which allows the reactor to be open each run while maintaining a low level of contamination in the reactor environment required for the advanced epitaxial deposition. During the deposition run the opening on the wall is covered by the special movable shutter with surface larger than opening to prevent gate valve overheating and particles formation. Unfortunately shutter also provides disturbance in the process flow dynamic (because to provide its movement shutter could not perfectly fit dimensions of the opening in the wall) and disturbance in the reactor thermal dynamic (because heat flow from the shutter is unavoidably different from the wall). Especially significant is thermal disturbance from the shutter in the reactor for high temperature epitaxial deposition (SiC – 1600 C, GaN – 1100 C) where reactor wall are usually water cooled while shutter is not. Because shutter components are logically located approximately on the wafer carrier level, the disturbance from it can have a significant negative effect on the deposition process which is extremely sensitive to uniformity of reactants flow and temperature distribution inside process reactor.

Description of the invention.

Invention is schematically shown (but not limited to) in figure 1. Cylindrical process reactor 2 is made of stainless steel. Reactants are introduced inside reactor 2 through the shower head type water cooled injector flange 1. Water cooled element 6 confine reactants flow to increase deposition efficiency. Wafer carrier 14 with substrates (Si, GaAs, Ge, InP, SiC, sapphire, etc.) for epitaxial deposition can be transferred by special vacuum robot (not shown in figure) through the passthrough 3 with flange 4 connected to gate valve (not shown) that separate reactor environment. Wafer carrier 14 is heated by the radiant heating element(s) 15 which high heating efficiency is provided by three horizontal heat shields 16 and vertical cylindrical heat shield 17. Wafer carrier is supported and spanned by the water cooled spindle 13 sealed from outside by commercially available vacuum rotary feedthrough (in most cases ferrofluidic type) 12 with implemented electrical motor. Process reactor 2 and rotary feedthrough 12 are fixed on water cooled base plate 5.

Passthrough 3 opening is covered by cylindrical shutter 7 with internal cavity for water cooling. Shutter 7 is located on at least two tubing 8 (only one is shown in figure) which is sealed to the reactor based plate 5 using bellow 9. Another end of the tubing 8 is connected to the moveable plate 10 installed using linear motion guide 19 connected through the spacer 20 to the reactor base plate 5. Plate 10 can move up and down by electro-mechanical actuator 11 fixed using stationary plate 18, guide 19, and spacer 20 on the reactor base plate 5. Cooling water is supplied to moveable shutter 7 through the flexible tubing (not shown) connected with the first tube 8, second tube 8 provide for cooling water return.

Movable tubing allows the water cooled shutter 7 to close passthrough 3 opening during epitaxial deposition run. At this time water cooled shutter 7 provides for uniform temperature and flow field around wafer carrier 14 that are required for uniform epitaxial deposition. When deposition run is over, the water cooled shutter 7 is moved down (by force transferred through tubing 8 from electro-mechanical actuator 11) and open passthrough 3 to transfer old carrier 14 from the reactor and new carrier 14 (not shown) in to the reactor.

History of the invention:

Water cooled cylindrical shutter was independently suggested and implemented by Alex Gurary and Vadim Boguslavskiy in D75 shell reactor on system 6; and by Keng Moy and Scott Elman in E300 GaN system. No system with water cooled cylindrical shutter was sold so far and this design was not presented in papers or on the conferences.

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